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J. Ignacio Conde-Ruiz and Paola Profeta

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The Pensions Institute
Cass Business School
City University
106 Bunhill Row London
EC1Y 8TZ
UNITED KINGDOM

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J. Ignacio Conde-Ruiz
FEDEA

Paola Profeta
Università di Pavia and Università Bocconi

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*Corresponding author: Paola Profeta, Istituto di Economia Politica, Università Bocconi, Via Gobbi 5, 20136 Milano (Italy). Tel: +390258365309, Fax:+390258365318. E-mail: paola.profeta@uni-bocconi.it. J.Ignacio Conde Ruiz, FEDEA, C/Jorge Juan 46, 48001 Madrid, Tel. +914359020, E-mail: conde-ruiz@fedea.es. We thank Vincenzo Galasso for his help and support throughout the entire project. We are grateful to Tito Boeri (Fondazione Rodolfo De Benedetti) to provide us with the ECHP data and the data of the survey on pensions conducted in Italy and especially to Mauro Maggioni for his help. We thank Mirko Cardinale (Watson Wyatt) for useful informations on complementary pensions and MORI research company for data on their pension polls. We are also grateful to Alberto Alesina and Pierre Pestieau for useful conversations and to Roberto Artoni, Henri Bogaert, Franco Peracchi, Panu Poutvaara, Ernesto Villanueva, participants at the IIPF 2002 Meeting, the workshop "International risk sharing and contracts" (Fiesole, 2002), seminars at CEBR in Copenaghen (2003) and Università Cattolica of Milano (2003), the EPCS 2003 Meeting, the CEPR 2003 conference in Napoli for helpful comments. The authors acknowledge financial support from Fundación Ramón Areces. All remaining errors are ours.

Abstract

Bismarckian social security systems are associated with larger public pension expenditures, a smaller fraction of private pension and lower income inequality than Beveridgean systems. This paper introduces a bidimensional voting model to account for all these features. Agents differ in age, income and in their ability to invest in the capital market. The voting game determines the degree of redistribution of the social security system -Bismarckian or Beveridgean- and the size of the transfer (for the low-income retirees). In an economy with three income groups, a small Beveridgean system is supported by low-income agents, who gain from its redistributive feature, and high-income individuals, who seek to minimize their tax contribution and to invest their resources in a private scheme. Middle-income individuals favor a large earning-related (Bismarckian) system. Hence, large (small) inequality is associated with a small Beveridgean (large Bismarckian) system and a large (small) private system. Additionally, a Beveridgean system is more likely to emerge when the capital market provides high returns.

Keywords: public versus private social security; pensions systems across European countries; income inequality, structure-induced equilibrium.

JEL Classification: H53, H55, D72.

1. Introduction

Together with the typical redistribution across generations, i.e. from young to old, PAYG social security systems may involve redistribution within the same generation across different income levels, i.e. from rich to poor. European social security systems differ in their degree of within-cohort redistribution. Italy, France and Germany have very high replacement rates at all income levels, while the UK and the Dutch systems provide lower replacement rates for higher earners than for lower earners (see Disney and Johnson 2001). Since contributions are typically proportional to earnings, this implies that the former countries have a social security system which does not redistribute within-cohort, while the latter ones appear to be quite redistributive. In other words, the former countries are of a "Bismarckian" type (there is a tight link between contributions and benefits, and thus low intragenerational redistribution) and the latter are "Beveridgean" (benefits are quite flat and contributions are proportional to earnings, thus intragenerational redistribution is large).

Our analysis has an empirical motivation. Countries with Bismarckian or Beveridgean systems differ in many other features additional to their degree of intragenerational redistribution. Using European Commission Household Panel (1993-1996) data, we calculate for each European country a "Beveridgean" index, which shows that a country like the United Kingdom is highly Beveridgean, while Italy and France are more Bismarckian. These data also suggest that Beveridgean social security systems tend to guarantee higher replacement rates to low-income individuals than Bismarckian ones. Additional evidence show that more Beveridgean countries are associated with lower public pension expenditures, a larger fraction of private pensions (second and third pillar) and higher returns from the private pensions in the capital market than countries that are more Bismarckian. Finally, we show that countries with Bismarckian systems have lower income inequality than Beveridgean ones.

The aim of this paper is to provide a positive theory of the redistributive design of the social security systems which accounts for many of the different features of these two alternative systems. We consider a political process of majoritarian voting, in which individuals determine the degree of redistribution of the system, and the size of the pension transfer (to the low-income retirees). A cucial element in our analysis is the difference in the agents' ability to invest in the capital market, with high-income agents earning higher returns. This assumption is supported, among others, by Blake (1996), who shows, using data for the United Kingdom, that the expected real return on assets increases with the level of wealth. In an economy with three income groups, we show that a small Beveridgean system may be supported by a coalition of low-income individuals, who benefit from its redistributive component, and high-income individuals, who seek to minimize their contributions to the system and to invest their resources in the private market. Middle-income individuals, instead, tend to support a Bismarckian system. A historical perspective, provided in the next section, supports our main result that Bismarckian systems are sustained by the middle-class, whereas Beveridgean systems are favored by low and high-income individuals.

Other papers in the political economy literature have addressed these issues. Earlier studies (see Galasso and Profeta 2002 for a review) suggest that Beveridgean systems, involving intragenerational redistribution, should enjoy larger support among low-income people than Bismarckian ones, which do not entail any intragenerational redistribution, and should thus be larger. These theoretical implications are at odds with the facts. The solution of this "puzzle" has represented the main issue on which the existing literature on the intragenerational redistributive component of the pension systems has focused. In particular, papers by Casamatta, Cremer and Pestieau (2000a, 2000b), Cremer and Pestieau (1998) and Pestieau (1999) have explained the negative relation between the degree of intragenerational redistribution and the size of the PAYG system, by studying the effect of the design of the benefit formula (Bismarckian versus Beveridgean) on the optimal size of the social security system. However, these studies do not address why a Bismarckian or a Beveridgean system with the features that we observe may arise. To this respect, this paper aims at providing a solution to the puzzle in a more comprehensive framework, which takes into account many additional features of the alternative systems.

We develop a bidimensional political economy model. In our overlapping generations model, there exist three income groups, with different access to the capital market. High-income individuals are able to earn higher returns from private savings than respectively middle and low-income agents. The design of the social security system is decided through a political process. People vote contemporaneously on two dimensions of the social security system: the pension level (of the low-income group), and the degree of intragenerational transfer in the benefit formula. The latter feature is captured by a Bismarckian factor, α, which represents the part of the pension depending on each individual's earning, rather than on average earnings. It is well known that in a multidimensional issue space Nash equilibria of a majoritarian voting game may fail to exist. Among the different solutions provided in the literature[1] we use issue-by-issue voting, which has been formalized in the literature with the concept of structural induced equilibrium (as in Conde-Ruiz and Galasso 1999, 2003). In our setting, low-income people support a public social security system, in particular a redistributive one (Beveridgean).

[1]Structure induced equilibrium, probabilistic voting, veto power or legislative bargaining and lobbying (see Persson and Tabellini, 2000).

This voting behavior is in line with the results of pension polls conducted in the UK, where the system is Beveridgean, by MORI (Market and Opinion Research International) in September 2000, which show that 58% of individuals in the low-income group[2] would accept the proposal "pay extra in tax to increase the state pension". Middle-income people may support a public social security system, in which case they are likely to prefer a Bismarckian system. This voting behavior is supported by the results of our calculations on the data from a survey conducted by Boeri, Borsch-Supan and Tabellini in 2002 in Italy, where the system is fairly Bismarckian (see table 1). In fact, these data show that middle-income individuals are relatively "happy" with the system (46% of them do not want a reform which reduces taxes and contributions, while 45% are in favor)[3]. Finally, high-income individuals oppose any public social security system, since they are able to obtain higher returns from investing in a private system. This voting behavior is consistente with the results in table 1: the majority of rich individuals (52.5%) agrees on a reform to reduce both the level of taxes and the pension benefits. In a Bismarckian system, high-income individuals are "not happy", since taxes are too high. They would prefer to reduce taxes, even if this implies a reduction of the pension level, since they can invest their income into the private market, and earn a higher return.

Two political equilibria may arise in our voting game. For high degrees of income inequality, a coalition of the extremes emerges: high-income individuals join the low-income people in a voting majority that supports a Beveridgean system, with a high level of pension for the low-income individuals. The overall size of the system is small, and a large private pillar arises. Interestingly, in this equilibrium high-income agents favor a more redistributive (Beveridgean) system, which lowers the cost of providing a pension to the low-income types, and thus allows them to invest more resources in the more profitable private pension system. If income inequality is low, middle-income people represents a majority which sustains a Bismarckian system, with a lower level of the pension for the low-income people, and a larger size of the system. This also leads to a smaller size of the private pillar.

The paper is organized as follows: the next section provides a historical perspective, which gives additional support to the main idea of the paper. The third section provides the empirical motivation of the paper, by performing an empirical analysis and collecting data on the different characteristics of the alternative systems. The following sections introduce the economic environment, the voting

[2] The low-income groups is identified by occupation.

[3] Notice that in the UK the question asked is whether to increase taxes and pensions, while in Italy is whether to decrease both, since a Beveridgean system is already quite small while a Bismarckian is very large.

game and the politico-economic equilibria. Section 7 concludes. All proofs are in the appendix.

2. A historical perspective

A brief detour of the adoption of the social security systems may help to shed some lights on the political forces behind the design of a Bismarckian *versus* a Beveridgean system. We shall argue that this historical perspective seems to validate the main result of our paper that Bismarckian systems are supported by the middle-class, whereas Beveridgean systems are favored by low and high-income individuals.

The first social security system was created in Germany by Bismarck in 1881, in connection with the foundation of the German Reich ten years earlier. Its main feature was to be an *insurance* system, i.e. a system where benefits were earning-related. On the opposite, the Beveridge report, published in 1942 in the UK, introduced the alternative idea of a *minimum* system, i.e. a system with flat-rate benefits for qualified retirees. The adoption of these two alternative systems depended on several factors, among which political elements played a crucial role (see Cutler and Johnson 2001). Interestingly, Bismarckian systems were introduced under the pressure of what we can define a "middle class", including influential industrial unions, narrow industrialized groups, politically important blue-collar; however, not of the poor. This middle class had considerably contributed to the movement which culminated in the unification of Germany. The introduction of the insurance system represented a way to combat dissent and to cement the alliance of these social groups with the Reich, in opposition to the socialist forces. In 1871 Bismarck wrote: "The only means of stopping the Socialist movement in its present state of confusion is to put into effect those Socialist demands which seem justifies and which can be realized within the framework of the present order of state and society" (Kohler et al., 1982). As a consequence, the government of the Reich played the main role in the organization of all insurance schemes (old-age, sickness, accident, disability).

During the same period, Britain was characterized by a liberal and democratic tradition, influenced by the individualistic ideology developed by leading political economists from Adam Smith to Ricardo. There were no collectivist political movements, nor a notion of supremacy of the state responsibility, while types of private and voluntary collective welfare were extended. In June 1889, the Times reported that "natural as free individual development is to the English in their island home, equally necessary is for Germany a rigid, centralised, all pervading state control....the german is accustomed to official control, official delays and police supervision from the cradle to the grave....whereas...self-help and spontaneous growth are better suited to Englishmen" (Kohler et al., 1982). However, only in 1942 the Beveridge report introduced in Britain an alternative model of social security. The Beveridgean scheme had a clear purpose: reducing poverty and raising the bottom income to a subsistence level, as a "weapon against mass poverty". This was achieved with flat-rate benefits aiming "at abolishing want, i.e., the number of people who need means-test to reach subsistence" (Hills et al. 1994). At the same time, flat rate benefits stressed the individualistic part: the state action has to be limited to redistribute in favour of the poor, while individuals privately provide for their own additional needs. Beveridge was convinced that the alternative Bismarckian earning-related system "is damaged to personal saving, while he wanted the maximum scope for private provision above his minimum" (Hills et al. 1994). The Beveridgean plan was created with the double intention of redistributing in favour of the poor and of leaving the maximum freedom to the rich to privately invest their income. This coalition between the extreme, the poor and the rich individuals, is evisaged also by Hills et al. (1994), who argue that "the old age pension campaign had a powerful momentum due to the fact that it was built upon an unholy and unintentional alliance between conservatives and socialists."

Interestingly, the principles on which the UK system was initially founded are still at work in the current purpose and design of the system[4]. According to the European Commission (2001)[5], the UK system is designed with the purpose of "targeting additional resources on the less well-off..., earnings-related benefits are a small part of state provision, and better-off workers are expected to rely on voluntary occupational and savings pension income". As a consequence, "private pensions contribute significantly to the income of pensioners, in particular higher up the income distribution. For the top quintile of pensioners, for example, state pensions account for only around a quarter of total income". This result is due to several features of the system. Very low-income individuals (with income below the Primary Threshold, PT, corresponding to 76 pounds per week in 2001) pay no contributions and receive only means-tested pension. Low and middle-income individuals, with an income between the Primary Threshold (PT) and the Upper Earning Limit (UEL, corresponding to 535 pounds per week in 2001), pay a 22.2% contribution tax on their labor income above the PT (of which 12.2% is due by the employer) and receive a flat Basic State Pension (BSP) and a State Earning Related Pension Scheme (SERPS)[6]. These individuals may choose to "contract

[4]See Disney and Johnson (2001) for a detailed description of the UK pension system.

[5]This report contains a document prepared by UK officials.

[6]SERPS typically corresponds to 25% of the average income in the best twenty years of contributions between the UEL and a Lower Earning Limit (LEL, corresponding to 67 pounds per week in 2001).

out" of the public system, in which case the contribution rate drops to 17.6%, and they do not receive any SERPS benefit, although they do obtain the flat BSP. It is important to notice that rich individuals, whose income is above the Upper Earning Limit (UEL), have their contribution rate reduced to 12.2% (due by the employer) on the income exceeding the UEL (they still pay 22.2% on the income between the PT and the UEL), however they accrue no additional pension rights for these contributions. If they "contract out", their tax rate is reduced to 17.6%, for the income between PT and UEL, and to 9.2% for that exceeding the UEL, but they receive no SERPS benefits.

To summarize, the design of the UK system achieves a large redistribution towards low-income individuals, with a particular attention to the level of pension received by the poor, while drawing few resources from high-income individuals. These two features are in line with our idea that Beveridgean systems may be supported by a voting coalition of low and high-income individuals: low-income favor the redistributive aspect, while high-income individuals support the reduced size of the Beveridgean system, which allows them a large use of private provisions.

3. Empirical Motivations

In this section we analyze several features that distinguish Bismarckian and Beveridgean systems. First, we use data from the European Commission Household Panel (ECHP) from 1993 to 1996 (4 waves) to classify the social security systems into Bismarckian or Beveridgean, according to their degree of redistribution. Second, we show that, contrary to the predictions of traditional political economy models of social security, Bismarckian systems are larger than Beveridgean ones. Third, we collect data on other features that differentiate the two alternative systems: the pension received by the low-income people, the degree of income inequality in the economy and the size of the private pension pillar.

The ECHP provides data on personal wage-salary earnings and pensions, together with many personal informations for a sample of individuals in the following European countries: Denmark, Netherlands, Belgium, Luxembourg, France, United Kingdom, Ireland, Italy, Greece, Spain, Portugal, Austria, Finland and Sweden[7]. For each country, we merge the data of two successive waves and calculate the replacement rates, defined as the ratio of post-retirement pension benefits to pre-retirement earnings. As in Nicoletti and Peracchi (2001, 2002) the replacement rates are calculated from the four waves of the ECHP on a subsample of people aged 55-69 at the time of retirement. Using the data on self-reported main activity status in each month, we select the individuals who retired in any month

[7]For a detailed description of the ECHP data see Peracchi (2002) and Nicoletti and Peracchi (2001, 2002).

between February 1993 and December 1996, and compute their replacement rate as the ratio of monthly pension benefits in the year of retirement (annual pension income divided by the number of months of retirement) and monthly earnings during the previous year. Pension income only includes old-age pensions, and earnings are the wage and salary earnings, net of taxes and social security contributions (with the exception of France, where income is gross[8]). The replacement rates for the Netherlands and Sweden are not computed, due to the lack of data[9]. Pooling for each country the replacement rates for individuals retiring at any month in the considered period, our sample sizes are still quite small, ranging from a maximum of 336 observations for Italy to a minimum of 15 observations for Finland.[10]

These observations are then partitioned in three income groups of equal size. For each group, we calculate the median[11] replacement rate. How the replacement rates vary across income groups depends on the country. We then construct a "Beveridgean" index as the average of the differences between the replacement rates of the three income groups (difference between the replacement rate of the low and the middle-income, of the middle and the high, and of the low and the high). Table 2 shows the results. As expected, the UK and Luxembourg have a higher Beveridgean index (respectively 0.548 and 0.5) followed by Denmark (0.34), while France, Italy and Spain show lower values (respectively 0.19, 0.169 and 0.139), thus being more Bismarckian.

Table 3 shows EC data on pension expenditures in European Countries (as % of GDP): the United Kingdom, Luxembourg and Netherlands enjoy lower pension expenditures than, for instance, Italy, France and Spain. A joint look at tables 1 and 2 - notice that Disney and Johnson (2001) classify the Dutch system as Beveridgean- suggests that more Beveridgean countries are typically associated with lower public pension expenditures than Bismarckian ones.

Table 4 displays the replacement rate for the low-income people. Countries with a higher Beveridgean index are associated with a higher replacement rate for low-income individuals, both calculated as the replacement rate of the bottom 33% and the bottom 20% of the distribution of earners. This suggests that more

[8]The use of gross income does not affect the replacement rate, as long as the ratio between net and gross earnings is equal to the ratio between net and gross pension benefits.

[9]For the Netherlands the monthly information on activity status is not available, while data for Sweden start from 1996 and thus no longitudinal informations are available in the 4 waves.

[10]Clearly, four waves are not sufficient to reproduce the entire lifetime profile of the observed individuals. In particular, we do not calculate the replacement rates for individuals that experience an unemployment spell before retirement. Nevertheless, the classification obtained from this data is in line with previous studies (Disney and Johnson, 2001).

[11]The median is less affected than the mean by the existence of atypical data. Notice that Nicoletti and Peracchi (2001, 2002) also use a median regression model.

Beveridgean systems offer a higher pension to low-income individuals.[12]

Several measures of income inequality from the World Development Indicators, World Bank 2000, are reported in table 5. The Gini index is significantly higher in the UK (36.1) than in Italy (27.3) or France (32.7). This is due to a higher concentration of income in the highest 20% in the UK, while the "middle" class (second, third and fourth 20% of the distribution) is significantly larger in Italy (55) and France (52.6) than in the UK (50.4). These results suggest that low-income inequality countries are associated with more Bismarckian systems.

Table 6 reports measures of the extension of the second pillar in the European countries. The data reported by the Green Paper of the European Commission 1997, based on the European Federation for Retirement Provision 1996 show very large differences across countries: pension funds assets represent 79.4% of the GDP in the UK and 88.5% in the Netherlands, while in France they absorb only 3.4% of the GDP and an even smaller amount (1.2%) in Italy. Supplementary pensions represent 28% of the total pension in the UK, and only 2% in Italy. These data suggest that the second pillar is much more developed in Beveridgean countries, where the public pillar is smaller, than in Bismarckian countries, where the public pension offers very large amounts. This relation is confirmed by the data on the total value of pension funds from 1998 to 2000. Market capitalization is 149.9% of GDP in the UK, while in France it is 38.9% and in Italy only 21.7%. Interestingly, table 6 also shows that higher returns from private pensions are associated with more Beveridgean systems: the real rate of return from pension funds is 10.2 in the UK, which is the highest value for the available countries.

4. The Economic Environment

We consider a two-period overlapping generations model. Every period two generations are alive: Young and Old. Population grows at a constant rate, $n > 0$. Individuals work in youth and retire in old age. Within each generation, there are three types of agents (j): low, middle and high ability ($j = L, M, H$), whose proportions are respectively ρ^L, ρ^M and ρ^H where $\rho^j < 1/2$ for each j. Wages are equal to the working abilities, and are respectively w^L, w^M and w^H, with $w^L < w^M < w^H$. We call $\overline{w}$ the mean wage income, $\overline{w} = \rho^L w^L + \rho^M w^M + \rho^H w^H$, and we further assume that the distribution of abilities and income is positively skewed so that the average income exceeds the median income, $\overline{w} > w^M$.

Agents value consumption in youth and in old age through a constant elasticity of substitution utility function. Young agents pay a proportional tax, τ_t, on their wage income and decide how much to save for old age consumption. We assume

[12] Notice that in our model the higher is the minimum pension, the higher is the replacement rate of the low-type individual.

that the three groups have different access to the capital market: low-income people obtain a lower return on their saving than middle-income people, who in turn obtain a lower return than high-income people. This is meant to capture the differences in informations, and the ability to manage their portfolio among individuals of different income groups. This assumption is in line with the results of Blake (1996), who shows that in the UK the expected real return on assets increases with the level of wealth: in the period 1991-92 the poorest investors expect a return on their portfolios of 7.99% while the wealthiest investors, who take a higher level of risk, expect a return of 17.96% . In particular, we assume that the middle-income group faces an interest rate which is weakly higher than the implicit average rate of return from the social security system, the population growth rate in our model, while the low-income group faces a lower interest rate. Therefore, an individual of ability j who saves 1 euro in period t will have a return[13] of $(1 + r^j)$ euro in period $t + 1$, with $r^L < n \leq r^M < r^H$.

Old agents do not work, but they receive a pension transfer, p_t^j, where t indicates the time and j the old agent type.

The representative type-j young agent in period t solves the following optimization problem:

$$\max_{c_t^{t,j}, c_{t+1}^{t,j}} U(c_t^{t,j}, c_{t+1}^{t,j}) = u(c_t^{t,j}) + \beta u\left(c_{t+1}^{t,j}\right) \tag{4.1}$$

subject to the individual budget constraints and to a non-negativity constraint on savings:

$$\begin{aligned} c_t^{t,j} + s_t^j &\leq w_t^j (1 - \tau_t) \\ c_{t+1}^{t,j} &\leq s_t^j (1 + r^j) + p_{t+1}^j \\ 0 &\leq s_t^j \end{aligned} \tag{4.2}$$

where $0 < \beta \leq 1$ is a factor of time preference, superscripts indicate the period when the agent was born and subscripts indicate the calendar time. The utility function $u(.)$ is strictly concave, with a coefficient of risk aversion greater than one[14] $(r_R(x) = -xu''(x)/u'(x) > 1)$.

Notice that the restriction on non-negative savings rules out the possibility of borrowing in youth against future pension payments. This represents a realistic assumption in a two overlapping generations model (see Diamond and Haussman,

[13] As it becomes clear in the next sections, the main results in the paper do not hinge on this assumption, $r^L < n$, which however guarantees that low-income young individuals are always in favor of the existence of the pension system no matter of the degree of intragenerational redistribution within the social security system.

[14] This assumption is consistent with the empirical estimates (see Auerbach and Kotlikoff, 1987).

1984) which is standard in this literature. When $s_t^j > 0$, the first order condition for an interior solution defines the optimal saving decision $s_t^{*,j}$ of a type-j individual:

$$u'(w_t^j(1-\tau_t) - s_t^j) = \beta u'\left(s_t^j(1+r^j) + p_{t+1}^j\right)(1+r^j) \tag{4.3}$$

Thus, savings are increasing in the interest rate and in disposable wage income and decreasing in the pension transfer. A large enough social security transfer totally crowds out private saving. Specifically, $s_t^j = 0$ if the level of pension is such that: $u'(w_t^j(1-\tau_t)) > \beta(1+r^j)u'(p_{t+1}^j)$.

4.1. The Social Security System

We consider a pay as you go (PAYG) social security system, in which workers contribute a fixed proportion of their labor income to the system, and the proceedings are divided among the old. A type-j retiree receives a pension, p_{t+1}^j, which consists of: i) a contributory part α which is directly related to individual earnings, w^j; and ii) a non-contributory part $1-\alpha$ which depends on average earnings, $\overline{w}$. The system is assumed to be balanced every period, so that the sum of all awarded pensions is equal to the sum of all received contributions. Therefore, at steady-state the average return from the social security system is given by the population growth rate, since we assume no labor productivity growth. These properties yield the following expression for the pension received by a type-j pensioner:

$$p_t^j = (1+n)\tau_t\left(\alpha_t w^j + (1-\alpha_t)\overline{w}\right)\phi(\alpha_t) \tag{4.4}$$

where $\phi(\alpha_t) \equiv (1-\eta(1-\alpha_t))$ characterizes the tax base net of distortion.

The variable α_t is the Bismarckian factor, that is the fraction of pension benefits that is related to contributions. When $\alpha = 1$ the pension scheme is income-related or purely Bismarckian; and when $\alpha = 0$ pension benefits are flat and the scheme is purely Beveridgean. For intermediate values, $0 < \alpha < 1$, due to the combination of a proportional labor income tax and the non-contributory part, there exists an element of within-cohort redistribution, from rich to poor, which is higher the lower is the Bismarckian factor α. In general, we may define a system[15] to be Bismarckian if $\alpha > 1/2$ and Beveridgean if $\alpha < 1/2$.

The parameter η identifies a distortionary effect associated to the non contributory part of the social security system. This is meant to capture the different impact of the social security tax rate on the labor-leisure decision under the two systems. In a Bismarckian system, there is a close link between the final pension

[15] Notice that the use of 1/2 is just for convenience, but does not affect our analysis, which aims at comparing more Bismarckian to more Beveridgean systems.

of a worker and her history of contributions, which can thus be interpreted as forced savings. In a Beveridgean system, on the other hand, this link does not exist, or it is weaker, and thus workers may interpret their contributions as a pure tax, that affects their labor decision. In other words, pensions are less costly, in terms of deadweight loss from taxation, in a Bismarckian than in a Beveridgean scheme[16].

As in Tabellini (2000) and Conde-Ruiz and Galasso (1999), the redistributive effect of the social security system can be crucial in our political game, because it increases the internal rate of return of the social security system for low ability young.[17].

The PAYG social security budget constraint is the following:

$$\sum_{j=\{L,M,H\}} \rho^j p_t^j = (1+n)\tau_t \overline{w} \phi(\alpha_t) \tag{4.5}$$

In every period, the social security system can be characterized by the pension received by a type-j individual ($j = M, L, H$), the payroll tax rate, and the Bismarckian factor: (p^j, τ, α). The budget constraints at equations 4.4 and 4.5 can then be used to calculate the pensions for the other two types of individuals. Hence, it is sufficient to have two such variables determined by the political process, in order to fully characterize the entire social security system. We choose these variables to be α and p^L. The choice of α is clear: our analysis focuses on the degree of intragenerational redistribution in the pension system. Among τ and the three levels of pensions, we concentrate on the level of pension for the low-income individuals, p^L, for several reasons. First, Disney et al. (1998) argue that the pension level of the low-income individuals plays a key role in shaping the redistributive structure of the system. Second, as suggested in section 2, one of the main purposes of the Beveridge Report (1942) in the UK was to guarantee through the social security system a minimum income to maintain a certain standard of living for the poorest. Finally, as we will discuss in section 5.2.1, the choice of p^L is more robust to different specifications of the model. We thus concentrate on this feature.

Once the low-ability pension and the Bismarckian factor are determined, using the PAYG budget constraint, the tax rate is also fully characterized. In other words, for a given p_t^L and α_t, we have that:

$$\tau_t = \frac{p_t^L}{(1+n)\alpha_t w^L + (1-\alpha_t)\overline{w})\phi(\alpha_t)} \tag{4.6}$$

[16]See Mulligan (2001) for an explanation of the deadweight cost of taxation in political economy models, and De Donder and Hindriks (1999) for an analysis of labor market distortions associated to social security systems.

[17]Evidence in favor of the existence of this within-cohort redistribution for the US system can be found in Boskin et al. (1987) and Galasso (2002).

and the pensions for the middle and high-type are respectively:

$$p_t^M = \frac{\left(\alpha_t w^M + (1-\alpha_t)\,\overline{w}\right)}{(\alpha_t w^L + (1-\alpha_t)\,\overline{w})} p_t^L \tag{4.7}$$
$$p_t^H = \frac{\left(\alpha_t w^H + (1-\alpha_t)\,\overline{w}\right)}{(\alpha_t w^L + (1-\alpha_t)\,\overline{w})} p_t^L$$

Notice that if the system is purely Beveridgean, $\alpha = 0$, the pensions are equal across types, $p_t^L = p_t^M = p_t^H$, while the replacement rates ($p_t^j/w^j = (1+n)\tau_t\overline{w}/w^j$ $\forall j = L, M, H$) are decreasing in labor income. On the other hand, if the system is purely Bismarckian, $\alpha = 1$, the pensions are increasing in labor income, $p_t^L < p_t^M < p_t^H$, while the replacement rates are equal across types ($p_t^j/w^j = (1+n)\tau_t$ $\forall j = L, M, H$).

4.2. The Economic Equilibrium

The following definition introduces the economic equilibrium, given the values of the social security system, which are determined by the political game.

Definition 4.1. *For a given sequence* $\left\{\tau_t, \alpha_t, p_t^L\right\}_{t=0}^{\infty}$, *and exogenous interest rates,* r^L, r^M *and* r^H, *an economic equilibrium is a sequence of allocations,* $\{s_t^j,\ c_t^{t,j},\ c_{t+1}^{t,j}\}_{j=\{L,M,H\}}^{t=0,..,\infty}$, *such that:*

- *In every period agents solve the consumer problem, i.e., every type* j *young individual maximizes her utility function* $U\left(c_t^{t,j}, c_{t+1}^{t,j}\right)$ *with respect to* s_t^j, *and subject to the individual budget constraints;*
- *The social security budget constraint is balanced every period;*
- *The goods market clears every period:*

$$\sum_{j=\{L,M,H\}} \left[(1+n)\rho^j c_t^{t,j} + \rho^j c_t^{t-1,j}\right] = (1+n)\overline{w}(1-\eta\,(1-\alpha_t)\,\tau_t)$$

The life-time utility obtained in equilibrium by a type-j young agent and the remaining life-time utility for a type j old agent are represented respectively by the following indirect utility functions:

$$v_t^{t,j}\left(p_t^L, \alpha_t, p_{t+1}^L, \alpha_{t+1}\right) = u\left(w_t^j\,(1-\tau_t) - s_t^{j*}\right) + \beta u\left(s_t^{j*}\left(1+r^j\right) + p_{t+1}^j\right) \tag{4.8}$$

$$v_t^{t-1,j}\left(p_t^L, \alpha_t\right) = u\left(K_t^j\left(1+r^j\right) + p_t^j\right) \tag{4.9}$$

where s_t^{j*} is the optimal level of saving obtained at equation 4.3, τ_t is a function of p_t^L and α_t by equation 4.6, p_{t+1}^j and p_t^j are functions of p_{t+1}^L, α_{t+1} by equations 4.7, and K_t^j is a constant which does not depend on current or future values of the social security system[18].

5. The Political Institution

The size and composition of the social security system are determined through a political process which aggregates agents' preferences over the low-ability agents' pension, $p^L \geq 0$, and the Bismarckian factor, $\alpha \in [0, 1]$.

Since the issue space is bidimensional (p^L and α), Nash equilibria of a majoritarian voting game may fail to exist. The literature provides alternative solutions (see Persson and Tabellini, 2000): probabilistic voting, lobbying, structure induced equilibrium, agenda setting. We adopt a majoritarian voting system and use the concept of issue by issue voting. This equilibrium concept has been formalized in the notion of structure induced equilibrium by Shepsle (1979), and it has been used in the context of political economy models of social security by Conde-Ruiz and Galasso (1999 and 2003). As in their papers, our game is intrinsically dynamic, since it describes the interaction among successive generations of workers and retirees. We therefore use their concept of subgame perfect structure induced equilibrium, which reduces the game to a dynamic issue-by-issue voting game.

Elections take place every period. All persons alive, young and old, simultaneously but separately cast a ballot over the two dimensions p^L and α. These two dimensions can be interpreted as two different jurisdictions: One has to decide over p^L, and the other over α. The final decision is the outcome of separate votes, one over each dimension.

Consider first the case of once-and-for-all voting, in which voters at time t determine the constant sequence of the parameters of the welfare state $\left(p^L, \alpha\right)$. In the absence of a state variable, this represents a static voting game, and the results in Shepsle (1979) apply. In particular, if preferences are single-peaked along every dimension of the issue space, a sufficient condition for $\left(p^{L*}, \alpha^*\right)$ to be an equilibrium of the once-and-for-all voting game is that p^{L*} represents the outcome of a majority voting over the jurisdiction p^L, when the other dimension is fixed at its level α^*, and viceversa.[19] In our environment, to guarantee that voters' preferences are single-peaked over the issue space (p^L, α), we need to impose the

[18] Specifically, $K_t^j = s_{t-1}^j (1 + r^j)$.

[19] See Persson and Tabellini (2000) for a simple explanation of how to calculate a structure induced equilibrium.

following restriction[20]:

$$\eta \leq \min\{(w^j\left(\overline{w}-w^L\right)-N^j\overline{w}\left(w^j-w^L\right))w^jw^L,(\overline{w}-w^L)/(2\overline{w}-w_L)\} \quad (5.1)$$

For a given p^L, the above condition guarantees that it is not possible to increase the intragenerational component within the social security system while at the same time decreasing the payroll tax, τ.

The results obtained in the case of once-and-for-all voting can be extended to the case of repeated voting, in which voters may only pin down the current values of p^L and α, although they may expect their current voting behavior to affect future voters' decisions. This general result has been proved by Conde-Ruiz and Galasso (1999 and 2003) in a similar economic and political environment.

The outcome of this simultaneous voting game depends on which variables to vote on. We let individuals vote on the low-ability pension p^L and the Bismarckian factor α. In this case the voting coalitions supporting the equilibrium outcome are the same regardless of whether individuals vote sequentially or simultaneously over each jurisdiction. The choice of any other pair of voting variables is not robust to changes in this specification. We will discuss this issue in more details in section 5.2.1.

5.1. Voting on the low-ability pension (p^L)

Regardless of the type of the social security scheme, the elderly are net recipients from the system. Therefore, for any value of α, they choose the pension transfer for the low-income individuals, p^L, that maximizes their pension (see equation 4.7), and hence its highest possible value, i.e. p^L s.t. $\tau = 1$.

Today's young individuals may be willing to vote in favor of the pension system, and thus to bear the cost of a current transfer, if their vote will also have an impact on its future size, and thus on their future benefits. In a once-and-for-all voting, a type-j young individual chooses her vote, p_j^L, by maximizing her indirect utility function with respect to a constant sequence of pensions, $p_{t,j}^L = p_{t+1,j}^L = p_j^L$.

The most preferred level of the low-ability pension for a type-j young individual is given by:

$$p_j^L(\alpha) \in \arg\max_{p^L} u\left(w_t^j\left(1-\tau_t\right)-s_t^{*,j}\right)+\beta u\left(s_t^{*,j}(1+r_j)+p_{t+1}^j\right) \quad (5.2)$$

Notice that a type-j worker will always be in favor of a zero low-ability pension (i.e. a zero payroll tax) if

$$\left(1+r^j\right) > (1+n)\phi\left(\alpha\right)\left(\alpha+(1-\alpha)\frac{\overline{w}}{w^j}\right) \quad (5.3)$$

[20] See the technical Appendix for the formal proof of this condition.

If, on the other hand, the previous condition is not satisfied, he will be in favor of a positive low-ability pension, which is implicitly defined by the following equation:

$$u'\left(w_t^j(1-\tau_t)\right)=\beta u'\left(p_{t+1}^j\right)(1+n)\phi(\alpha_t)\left(\alpha_t+(1-\alpha_t)\left(\overline{w}/w_t^j\right)\right) \tag{5.4}$$

The intuition is the following: if the rate of return of his saving technology, $(1+r^j)$, is higher than the rate of return of social security, $(1+n)\phi(\alpha)(\alpha+(1-\alpha)\overline{w}/w^j)$, a type-$j$ worker would prefer to transfer resources to the future by using the private saving technology rather than the social security system. Thus, he will prefer a zero low-ability pension and positive savings. Otherwise, he will choose a positive low-ability pension and no private savings[21].

It is important to notice that the young individual's vote depends on the type of social security system. For instance in a purely Bismarckian system ($\alpha=1$), a type-j young votes for a positive low-ability pension if $r^j \leq n$; while in a purely Beveridgean one ($\alpha=0$) he will support a positive low-ability pension if $r^j<(\overline{w}/w^j)(1+n)\phi(\alpha)-1$.

Low-income young always vote for a positive pension in a Bismarckian system, $r^L<n$, and they are willing to vote for a positive pension in a Beveridgean system, provided that the distortion is not too large, $\eta\leq 1-(1+r^L)w^L/(1+n)\overline{w}$. High-income young, on the other hand, always vote for a zero low-ability pension (i.e. a zero payroll tax), since they have access to a better saving technology, $r^H>n$, and are net contributors in a redistributive (Beveridgean) system ($w^H>\overline{w}$). The voting behavior of the middle-income young depends instead on the degree of redistribution (α) and on the performance of the social security system relative to the capital market (r^M versus n).

Finally, to complete the ordering of the votes over p^L, it is sufficient to notice that if both low and middle-income young choose to vote for a positive low-ability pension, the middle-income young will vote for a larger pension[22]: $p_M^L(\alpha)>p_L^L(\alpha)$. The intuition is straightforward: middle-income individuals want to move more resources into the future than low-ability agents. Since they use the social security system as their only saving technology, they will prefer higher pensions[23].

In order to simplify the exposition, in what follows we focus on the more realistic case, in which middle-income young individuals prefer the private technology as a saving device[24]. In this case the identity of the median voter depends on

[21] Notice that, for a given level of α, voting over the jurisdiction p^L is completely equivalent to voting over the jurisdiction τ (the first order conditions for p^L and for τ are exactly the same). Individuals always vote the level of τ or of the low-ability pension that transfers the optimal level of resources into the future. In fact, for a given α there is a one-to-one correspondence between the two variables (p^L and τ) through the balanced social security budget constraint.

[22] Since the coefficient of risk aversion is larger than one, it is easy to show that $dp_j^L/dw^j<0$.

[23] This result was already in Casamatta et al. (2000a).

[24] Notice that this constitutes a more conservative assumption vis-à-vis the introduction of the

the size of the low-income group. If the median voter is a low-type young (when $\rho^L \geq n/(2(1+n)))$, p^L is positive and the middle and high-income types complement their transfers of resources into the future through private savings. If the median voter is a middle-income young (when $\rho^L < n/(2(1+n)))$, there are no pensions and all transfers into the future occur through private savings.

5.2. Voting on the Bismarckian factor

The old have again a simple choice. Since they are no longer required to contribute to the system, they vote for the Bismarckian factor that maximizes their current transfer for a given level of p^L. Clearly, low-type old are indifferent on this dimension, because their final pension, p^L, is already determined. Middle and high-income old vote for $\alpha = 1$ (a purely Bismarckian system), since, for a given low-ability pension, a Bismarckian system maximizes their pension transfers:

$$\frac{dp^j}{d\alpha} = \frac{\overline{w}\left(w^j - w^L\right)}{\left(\alpha w^L + (1-\alpha)\,\overline{w}\right)^2} p^L > 0;\ j = M, H \tag{5.5}$$

We now turn to the young. In a once-and-for-all voting game, the voting decision of a type-j young individual amounts to maximizing her indirect utility (equation 4.9) with respect to current and future Bismarckian factors, $\alpha_t = \alpha_{t+1} = \alpha$, for a given value of current and future low-ability pensions, $p_t^L = p_{t+1}^L = p^L$. To appreciate the voting behavior of the young, notice that, for a given value of p^L, an increase in the Bismarckian factor has a double effect: it raises the pensions to the middle and high types (see equation 4.7), and hence it increases the tax rate to finance these additional pension transfers (see equation 4.6). The next proposition provides a characterization of their voting behavior and the main result of the paper.

Proposition 5.1. *Low-ability young individuals choose a purely Beveridgean system ($\alpha = 0$). Type-j young individuals, with $j = M, H$ vote for:*

$$\begin{array}{lll} \alpha > 1/2 & \text{if} & r^j < R^j \\ \alpha < 1/2 & \text{if} & r^j > R^j \end{array} \tag{5.6}$$

where

$$1 + R^j = (1+n)\,\frac{(2-\eta)^2}{4}\,\frac{w^j - w^L}{w^j(1-\eta) - \frac{w^j}{\overline{w}} w^L} \tag{5.7}$$

social security system, since in the alternative case a middle-income young voter would choose a positive pension level.

This proposition suggests that low-income young prefer a Beveridgean system, which, for a given p^L, reduces their wage bill. The voting behavior of the middle and high-income young is more interesting to analyze. Three elements are crucial in their voting decision:

1. the performance of the social security system relative to the saving technology $(1+n)/(1+r^j)$: a better performance increases the support for a Bismarckian system;

2. the distortion factor η associated to the non-contributory part of the system: a larger distortion increases the support for a Bismarckian system; and

3. the redistributive element $(w^j/\overline{w})$: a lower cost of redistribution (smaller $w^j/\overline{w}$) increases the support for a Beveridgean system.

High-income types are net contributors to a redistributive (Beveridgean) system. Nevertheless, they are willing to sustain a Beveridgean system ($\alpha < 1/2$) if the return on their private assets is sufficiently high. The intuition is straightforward: a Beveridgean system reduces their pension transfer, but also their contributions to the system, which may more conveniently be invested in a private asset. This represents a crucial insight of the model. It suggests that alternative saving opportunities may be relevant in shaping the individual preferences over the social security system. If, on the other hand, the return on private asset is not sufficiently high, high-income choose a Bismarckian scheme[25].

Middle-income types also prefer a Beveridgean system if the return on their private assets is sufficiently high. Their preferred level of the Bismarckian factor can be larger or smaller than the one preferred by the high-type, depending on the rate of return.

To summarize, if high types young obtain sufficiently high returns on private assets, a Beveridgean system is always supported by a coalition of the extremes: low and high types young. Thus, if they constitute a voting majority, or if they are joined by the middle-type young, a Beveridgean system arises. If, on the other hand, they do not constitute a majority, and the middle-type young oppose a Beveridgean system, a Bismarckian system arises.

5.2.1. Discussion

In our model, the political decision over the social security system includes two jurisdictions (i.e, issues) (α, p^L), while the payroll tax τ is residually determined to

[25] This result holds for high-income savers. High type non-savers wish to transfer resources into the present. Thus, even for low private returns, they may be willing to support a Beveridgean scheme in order to decrease today's contributions, and hence to increase today's net income.

balance the budget constraint. We refer to this political system as a p^L*-legislature.* Alternatively, we could consider a τ*-legislature,* i.e. a system where the issues to be decided are τ and α. In this case, the voting behavior would be different. In particular, while voting over τ for a given α provides the same results as voting over p^L for a given α (see section 5.1), the voting behavior over α would be different. To see this, consider the voting behavior of a high-type young individual when $r^H \geq R^H$ (see equation 5.7). Under the p^L*-legislature,* this individual supports a Beveridgean system. However, under the τ*-legislature* he would vote for a pure Bismarckian system. This is because supporting a more Beveridgean system would not diminish his tax burden (as in the p^L*-legislature*), while it would decrease his pension.

A justification for our setting, in addition to the arguments in section 4.1, is that the p^L*-legislature* is robust to sequential voting, while the τ*-legislature* is not. Consider a two stages sequential voting where α is decided at the first stage and p^L (in a p^L*-legislature*) or τ (in a τ*-legislature*) at the second stage. Consider again the voting behavior of a high-type young individual when $r^H \geq R^H$. Under the p^L*-legislature,* with sequential voting this individual supports a Beveridgean system at the first stage, exactly as he does with simultaneous voting. On the other hand, under the τ*-legislature*, with sequential voting he still supports a Beveridgean system at the first stage (differently from what he does with simultaneous voting) because he knows that a more Beveridgean system at the first stage implies a lower tax rate to be paid at the second stage.

6. The Political Economy Equilibrium

The previous sections have separately analyzed the voting behavior of all individuals along the two dimensions of the issue space, i.e., the low-ability pension and the Bismarckian factor. Since preferences are single peaked (under condition 5.1), we can now apply Shepsle's (1979) result, and characterize the structure induced equilibria of the game. The next proposition characterizes the politico-economic equilibrium outcomes of our voting game.

Proposition 6.1. *When there is a sufficiently large number of low-income individuals, i.e.,* $\rho^L > n/(2(1+n))$*, and low and middle-income young constitute a majority of the voters, i.e.* $\rho^L + \rho^M > (2+n-\rho^L)/2(1+n)$*, there exists a structure induced equilibrium* $\left(p^{L*}, \alpha^*\right)$ *of the voting game, such that:*

i) For $r^M > R^M$*, a Beveridgean system prevails (*$p^{L*} = p_L^L$ *and* $\alpha^* < 1/2$*)*

ii) For $r^M < R^M$ *and* $r^H < R^H$*,* $p^{L*} = p_L^L > 0$

$$\text{and the system is} \begin{cases} \text{Bismarckian}(\alpha^* > 1/2) & \text{for } \rho^L \leq (2+n)/(3+2n) \\ \text{purely Beveridgean } (\alpha^*=0) & \text{otherwise} \end{cases}$$

iii) For $r^M < R^M$ and $r^H > R^H$, $p^{L*} = p_L^L > 0$

$$\text{and the system is} \begin{cases} \text{Bismarckian}(\alpha^* > 1/2) & \text{for } \rho^M > (\rho^L + n)/(2(1+n)) \\ \text{Beveridgean } (\alpha^* < 1/2) & \text{otherwise} \end{cases}$$

First notice that if there is a small proportion of low-income young, i.e., if $\rho^L < n/(2(1+n))$, no social security system would arise in equilibrium, i.e. $p^{L*} = 0$. This case arises from section 5.1 and represents a usual result in the literature.

Case i) of the previous proposition suggests that a Beveridgean system is an equilibrium if the middle-income young obtain sufficiently high returns from private savings and thus join the low-income in supporting a Beveridgean system, regardless of the vote of the high-income young.

Case ii) points out that a Bismarckian system arises as an equilibrium when both high and middle-income young have sufficiently low returns from private savings, provided that the low-income young do not constitute a majority of the voters. In this case in fact, low-income would be the only ones to benefit from a Beveridgean system. This result suggests that countries with more efficient capital markets, providing higher returns, are more likely to have a Beveridgean system.

The most interesting result arises when middle-income young individuals do not enjoy sufficiently high returns from private savings, but high-income young individuals do (case iii). In this case, which is illustrated in figure 1, a Beveridgean system may be supported by a voting coalition of low and high-income young individuals. This equilibrium resembles the "ends against the middle" result in Epple and Romano (1996): in the presence of private alternative, high and low-income individuals prefer lower public expenditure (with the rich choosing more private consumption) against the middle-income who would prefer more public expenditure. However, if there exists a large share of middle types, a Bismarckian system arises. In this sense, this result suggests that more inequality, as measured by a large share of low and high-income young, is more likely to be associated with Beveridgean systems, and viceversa.

To summarize, proposition 6.1 delivers predictions which are consistent with the empirical relations that motivated our analysis (see section 3): PAYG Beveridgean systems are associated with more income inequality than Bismarckian systems (see table 5) and they are more likely to emerge in countries with more developed capital markets, which provide higher returns (see table 6).

The next Corollary delivers an additional empirical predictions and show that our bidimensional voting model is able to account for the "puzzle", i.e. the negative relation between the degree of redistribution of a system (α) and its size (τ).

Corollary 6.2. *The equilibrium level of the pension of low-income type is weakly decreasing in α, while the equilibrium tax rate is weakly increasing in α.*

Corollary 6.2 shows that a Beveridgean system is associated with a higher pension for the low-income individuals, as found in the data (see table 4). Moreover, Beveridgean systems are associated with a lower size of the PAYG system (a lower tax rate) than Bismarckian ones (see table 3). The latter result was already in Casamatta et al (2000a). In our model, this is because a Beveridgean system is supported by a coalition of low-income agents, who seek a high pension for themselves, and high-income types, who favor a high pension for the low-income types if combined with a low tax rate, so as to pay lower taxes and invest more in the private assets.

Finally, what happens if we relax the assumption of once-and-for-all voting and consider a repeated game, in which voters may only determine the current Bismarckian factor and low-ability pension? Following Conde Ruiz and Galasso (1999, 2003) the results in proposition 6.1 can be generalized to a repeated game. There exists a system of punishment and rewards, which makes the equilibrium outcome of the static game a *subgame perfect* equilibrium outcome of the repeated game. The intuition is straightforward. Old agents' voting behavior does not depend on tomorrow's policy and thus on the specification of the game. Young individuals, who were in favor of a positive social security system (either Beveridgean or Bismarckian) in the static game, will now be willing to enter an "implicit contract" among successive generations of voters to sustain the welfare state. This "implicit contract" specifies that, if current young support the existing welfare system, they will be rewarded with a corresponding transfer of resources in their old age, otherwise they will be punished, and receive no transfers.

7. Conclusions

This paper provides a comprehensive analysis of the degree of intragenerational redistribution in the social security systems. Using European Commission Household Panel (4 waves) data we show that more Bismarckian systems are associated with larger pension expenditures. These data also suggest that Beveridgean systems are characterized by a very high level of the replacement rate for the low-income people. Moreover, Bismarckian systems tend to be associated with less income inequality in the economy and with a lower size of the private pillar. All these features motivate our study, which aims at jointly determining the pension level (for the low-ability) and the degree of redistribution of the pension formula (the Bismarckian factor) in a bidimensional political economy approach. The explanation is very intuitive: in an economy with three groups, which differ in income and in their ability to invest in the capital market, low-income people support a Beveridgean system, which redistributes in their favor; middle-income favor an earning-related system, with a tight link between contributions and benefits (if the alternative private pillar does not provide them with high enough returns), while high-income people prefer a redistributive system, which guarantees a pension to the low-income types and is combined with a smaller size of the public system (and thus, of the contributions to be paid), so that they can invest more in the private system, which guarantees them higher returns. If income inequality is large, a coalition of the extreme emerges where high and low-income people form a voting majority which supports a (small) Beveridgean system, and a large private pillar may arise. If income inequality is small, middle-income and elderly people represent a majority which sustains a (large) Bismarckian system and the private pillar turns out to be small. Additionally, we show that when capital markets are more efficient and provide higher returns, Beveridgean systems are more likely to emerge.

This analysis could be extended in several directions. First, the role of the intragenerational redistributive component in the reforms of the social security system has been generally disregarded in the political economy literature. With our theoretical framework, one may ask how the aging process would modify the design of the social security systems with respect to their degree of intragenerational redistribution, or how reforms of the degree of redistributiveness of the public PAYG system would affect the development of the private pension schemes. If the aging process implies a larger PAYG system, high-income individuals will tend to shift their support in favor of a more Bismarckian scheme. An indirect evidence of this effect can be found in the Italian reform of 1995, which, after a large increase of pension expenditures, introduced a more Bismarckian scheme, by changing the benefit formula from defined benefits to defined contributions. Second, the data collected in this analysis and the predictions of the model suggest that the pension systems in European countries differ in many aspects. Many questions arise: what role will current policies, such as the harmonization of the pension systems in a European context, have on the differences among European pension systems? Do we expect European countries to react differently to current common trends, such as the aging process? All these questions suggest directions for future research.

A. Appendix

A.1. Single peakness

If $\eta \leq \min\{(w^j\left(\overline{w}-w^L\right)-N^j\overline{w}\left(w^j-w^L\right))w^jw^L, (\overline{w}-w^L)/(2\overline{w}-w_L)\}$, preferences of all individuals are single-peaked in both $p^L$and α.

Proof

i) Some straighforward algebra is sufficient to show that $v_t^{t,j}\left(p^L,\alpha\right)$ is a concave function of p^L.

ii) To analyze the preferences over α, first notice that, for a given p^L, an increase of α increases the tax rate (equation 4.6) only if $\eta \leq (\overline{w}-w^L)/(2\overline{w}-w_L)$:

$$\frac{\partial\tau}{\partial\alpha}=-\frac{-p^L[\left(\alpha w^L+(1-\alpha)\overline{w}\right)\eta+\phi\left(w^L-\overline{w}\right)]}{((1+n)\phi\left(\alpha\right)\left(\alpha w^L+(1-\alpha)\overline{w}\right)^2}$$

In this case, an increase of α (for a given p^L) reduces the utility of a low-type (equation 4.8), who, as a consequence, will vote for $\alpha=0$. On the other hand, an increase of α increases the middle and high type's pensions (equations 4.7):

$$\frac{\partial p^j}{\partial\alpha}=\frac{\overline{w}(w^j-w^L)p^L}{(\alpha w^L+(1-\alpha)w^H)^2}>0 \text{ for } j=M,H$$

Thus, for middle and high-type savers, $s^{*,j}>0$, and by the envelop theorem, we can concentrate on the effect on the lifetime income (indicated by I^j):

$$\frac{\partial I^j}{\partial\alpha}=\frac{p^L}{(\alpha w^L+(1-\alpha)\overline{w})^2}\left[-\frac{w^j[\left(\alpha w^L+(1-\alpha)\overline{w}\right)\eta+\phi\left(w^L-\overline{w}\right)]}{(1+n)\phi\left(\alpha\right)^2}+\frac{\overline{w}(w^j-w^L)}{1+r^j}\right]=0$$

If an internal solution exists, there are two levels of α such that the first order condition is equal to zero:

$$\begin{aligned}\alpha_A^j &= a+b\\ \alpha_B^j &= a-b\end{aligned}$$

where

$$\begin{aligned}a &= \frac{w^j\left(\overline{w}-w^L\right)-\left(\left(1-\eta\right)N^j\left(\overline{w}\left(w^j-w^L\right)\right)\right)}{\eta N^j\overline{w}\left(w^j-w^L\right)}\\ b &= \frac{\sqrt{\left(\left(\overline{w}-w^L\right)w^j\right)^2-N^j\left(\overline{w}\left(w^j-w^L\right)\right)\left(\overline{w}-\left(1-\eta\right)w^L\right)w^j}}{\eta N^j\overline{w}\left(w^j-w^L\right)}\end{aligned}$$

Since $\eta N^j \overline{w}\left(w^j - w^L\right)$ is always positive, a sufficient condition to guarantee that preferences are *single peaked* is to impose that $\alpha_A^j > 1$ (notice that $\alpha_A^j > \alpha_B^j$). After some algebra, this condition turns out to be the following:

$$\eta < \frac{w^j\left(\overline{w} - w^L\right) - N^j \overline{w}\left(w^j - w^L\right)}{w^j w^L}$$

Therefore, $\eta \leq \min\{(w^j\left(\overline{w} - w^L\right) - N^j \overline{w}\left(w^j - w^L\right))w^j w^L, (\overline{w} - w^L)/(2\overline{w} - w_L)\}$ guarantees that preferences over α are single-peaked. ■

A.2. Proof of Proposition 5.1

We know that, if $\eta \leq (\overline{w} - w^L)/(2\overline{w} - w_L)$ (as assumed by condition 5.1) a low-income young individual votes for $\alpha = 0$. To analyze the preferred level of α for middle and high-type savers, $s^{*,j} > 0$, by the envelop theorem, we can concentrate on the effect on the lifetime income (indicated by I^j):

$$\frac{\partial I^j}{\partial \alpha} = \frac{p^L}{\left(\alpha w^L + (1-\alpha)\overline{w}\right)^2}\left[-\frac{w^j[\left(\alpha w^L + (1-\alpha)\overline{w}\right)\eta + \phi\left(w^L - \overline{w}\right)]}{(1+n)\phi\left(\alpha\right)^2} + \frac{\overline{w}(w^j - w^L)}{1+r^j}\right] = 0$$

Since preferences are concave in the interval $\alpha \in [0,1]$, if the first order condition of a type-j individual is positive, $\frac{\partial I^j}{\partial \alpha} > 0$, at $\alpha = 1/2$, her most preferred level of α is achieved for $\alpha > 1/2$ (Beveridgean) and viceversa. It can be proved that the first order condition is positive at $\alpha = 1/2$ if and only if:

$$1 + r^j < (1+n)\frac{\left(2-\eta\right)^2}{4}\frac{w^j - w^L}{w^j\left(1-\eta\right) - \frac{w^j}{\overline{w}}w^L}$$

Therefore the above condition guarantees that the individual votes for a Beveridgean system.

Non-savers are at a corner solution in their saving decision, and thus the envelop theorem does not apply. In particular, they would like to borrow against future pension wealth to transfer resources into the present. Analytically,

$$-\frac{\partial U}{\partial c_t^t} + \beta\frac{\partial U}{\partial c_{t+1}^t} < 0$$

For middle and high type non-savers, the choice of α amounts to maximize the following expression: $U(w^j(1-\tau)) + \beta U(p^j)$. Thus, we have:

$$\frac{p^L}{\left(\alpha w^L + (1-\alpha)\overline{w}\right)^2}\left(-\frac{\partial U}{\partial c_t^t}\frac{w^j[\left(\alpha w^L + (1-\alpha)\overline{w}\right)\eta + \phi\left(w^L - \overline{w}\right)]}{(1+n)\phi\left(\alpha\right)^2} + \beta\frac{\partial U}{\partial c_{t+1}^t}\frac{\overline{w}(w^j - w^L)}{1+r^j}\right)$$

The previous FOC is always positive for $\alpha = 1/2$ if

$$1 + r^j < (1+n)\frac{(2-\eta)^2}{4}\frac{w^j - w^L}{w^j(1-\eta) - \frac{w^j}{\overline{w}}w^L}$$

and therefore $\alpha^j > 1/2$. ■

A.3. Proof of Proposition 6.1

Notice that since $\left(1 + r^M\right) > (1+n)\phi(\alpha)\left(\alpha + (1-\alpha)\frac{\overline{w}}{w^M}\right) \forall\alpha$ and $\eta \leq (\overline{w} - w^L)/(2\overline{w} - w_L)$, the low-type young vote for a purely Beveridgean system and the middle-type young vote always for a zero low-ability pension. We assume that young low and middle always constitute a majority ($\rho^L + \rho^M > (2 + n - \rho^L)/2(1+n)$) and that the median voter over the jurisdiction p^L is a low-type young ($\rho^L \geq n/2(1+n)$, i.e. $p^{L*} = p^L_L > 0$). We thus have the following three cases:.

i) $r^M > R^M$: The middle-young always vote for $\alpha > 1/2$. Since $\rho^L + \rho^M > (2+n-\rho^L)/2(1+n)$, the middle-young is always the median voter over the jurisdiction α (regardless of the preferences of the high) and he supports a Beveridgean system ($\alpha > 1/2$).

ii) $r^M < R^M$ and $r^H < R^H$. In this case the middle and high young vote for $\alpha > 1/2$. Since old low types are indifferent, $2 + n - \rho^L$ is the size of total population. The median voter over the jurisdiction α is a middle or a high-young only if the low types are less than half the total population ($\rho^L < (2+n)/(3+2n)$), otherwise the median voter is a low-young type. Therefore the system is Beveridgean ($\alpha^* = 0$) only if $\rho^L > (2+n)/(3+2n)$ and Bismarckian ($\alpha^* > 1/2$) otherwise.

iii) $r^M < R^M$ and $r^H > R^H$. In this case, the middle-young vote for a Bismarckian system $\alpha > 1/2$ and the high-young vote for a Beveridgean system $\alpha > 1/2$. The system is Beveridgean if the low and high-young are the majority of the population, i.e. $\left(\rho^H + \rho^L\right)(1+n) > (2+n-\rho^L)/2$, which is equivalent to say that $\rho^M < (\rho^L + n)/2(1+n)$. Otherwise, if the middle young are the majority, $\rho^M \geq (\rho^L + n)/2(1+n)$, the system is Bismarckian ■.

A.4. Proof of Corollary 6.2

The most preferred level of a low-ability pension for a low ability worker is implicitly defined by the following first order condition:

$$FOC^L(p^L_L) = -u'\left(w^L\left(1 - \frac{p^L_t}{(1+n)(\alpha_t w^L + (1-\alpha_t)\overline{w})\phi(\alpha_t))}\right)\right) +$$
$$\beta u'\left(p^L\right)(1+n)\phi(\alpha)(\alpha + (1-\alpha)(\overline{w}/w^L_t)) = 0$$

Using the implicit function theorem we can calculate $dp_L^{L*}(\alpha)/d\alpha = -(dFOC^L(p_L^L)/d\alpha)$ / $SOC(p_L^L)$. Then, $sign\left(dp_L^{L*}(\alpha)/d\alpha\right) = sign(dFOC^L(p_L^L)/d\alpha)$, since $SOC(p_L^L) \leq 0$. By differentiating $FOC^L(p_L^L)$ with respect to α, we obtain that:

$$\frac{dFOC^L(p_L^L)}{d\alpha} = u''(c_t^L)w^L \left(\frac{p_t^L(1+n)\phi(\alpha_t)\left(\overline{w} - w^L\right))}{\left((1+n)\left(\alpha_t w^L + (1-\alpha_t)\overline{w}\right)\phi(\alpha_t)\right))^2} \right) +$$
$$\beta u'\left(p^L\right)(1+n)\left[\eta(\alpha + (1-\alpha)(\overline{w}/w_t^L)) + \phi(\alpha)\left(1 - (\overline{w}/w_t^L)\right)\right]$$

Since $\eta \leq (\overline{w}-w^L)/(2\overline{w}-w_L)$, $dFOC^L(p_L^L)/d\alpha$ is negative. Therefore $dp_L^{L*}(\alpha)/d\alpha \leq 0$.

The most preferred level of tax for a low ability young individual is implicitly defined by the following first order condition:

$$FOC^L(\tau_L^L) = -u'\left(w^L(1-\tau)\right)w^L + \beta u'\left(p^L\right)(1+n)\phi(\alpha)\left(\alpha w_t^L + (1-\alpha)(\overline{w})\right) = 0$$

Using the implicit function theorem, we can calculate $d\tau_L^{L*}(\alpha)/d\alpha = -(dFOC^L(\tau_L^L)/d\alpha)$ / $SOC(\tau_L^L)$. Then, $sign\left(d\tau_L^{L*}(\alpha)/d\alpha\right) = sign(dFOC^L(\tau_L^L)/d\alpha)$, since $SOC(\tau_L^L) \leq 0$. By differentiating $FOC^L(\tau_L^L)$ with respect to α, we obtain that:

$$\frac{dFOC^L(\tau_L^L)}{d\alpha} =$$
$$\beta(1+n)\left[\phi'(\alpha)\left(\alpha w_t^L + (1-\alpha)\overline{w}\right) + \phi(\alpha)\left(w_t^L - \overline{w}\right)\right]u'\left(p^L\right)\left[\frac{u''\left(p^L\right)p^L}{u'\left(p^L\right)} + 1\right] =$$
$$\beta(1+n)\left[\phi'(\alpha)\left(\alpha w_t^L + (1-\alpha)\overline{w}\right) + \phi(\alpha)\left(w_t^L - \overline{w}\right)\right]u'\left(p^L\right)\left[1 - r_R(p^L)\right]$$

Since $r_R(p^L) > 1$ by assumption and $\eta \leq (\overline{w} - w^L)/(2\overline{w} - w_L)$, then $d\tau^*(\alpha)/d\alpha \geq 0$ ■.

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Table 1. Results of a survey pension in Italy

	Would you accept a reduction in contribution and pension? *	
Rich**	Yes No Don't know	52.5% 37.5% 10%
Middle**	Yes No Don't know	45% 46% 9%
Poor**	Yes No Don't know	35% 50% 15%

Source: our calculations from data of Boeri. Tabellini. Borsch-Supan (2002)
** Precise question: Would you accept the following proposal: a reduction by 50% of your contributions to the public pension system, receiving this amount cash, and a reduction of your pension as if you had worked 50% of your salary from tomorrow on?*
*** Income groups divided by occupations*

Table 2: Replacement Rates Across Income Groups in European Countries

Country	Germany	Denmark	Netherlands	Belgium	Luxembourg	France	United Kingdom	Ireland	Italy	Greece	Spain	Portugal	Austria	Finland
Low	n.a.	1.2749	n.a.	0.9208	3	1.0295	2.1667	0.7084	1.0500	0.9722	1.0707	1.2177	1.0303	1.3495
Middle	n.a.	0.7378	n.a.	0.7914	0.9053	0.8300	0.6140	0.6535	0.8496	0.7938	0.8686	0.7661	0.6603	1.0421
High	n.a.	0.6524	n.a.	0.7143	0.8205	0.7450	0.5118	0.6043	0.7902	0.9143	0.8491	1.0000	0.7129	1.1766
(L-M)/L	n.a.	0.4213	n.a.	0.1406	0.6982	0.1938	0.7166	0.0775	0.1909	0.1836	0.1887	0.3708	0.3591	0.2278
(M-H)/M	n.a.	0.1157	n.a.	0.0974	0.0937	0.1024	0.1664	0.0753	0.0699	-0.1519	0.0225	-0.3052	-0.0796	-0.1291
(L-H)/L	n.a.	0.4883	n.a.	0.2243	0.7265	0.2763	0.7638	0.1469	0.2475	0.0595	0.2070	0.1788	0.3081	0.1282
Beveridgean index	n.a.	0.3418	n.a.	0.1541	0.5061	0.1908	0.5489	0.0999	0.1694	0.0304	0.1394	0.0814	0.1958	0.0756
n° obs. Low		30		25	7	64	37	21	112	35	40	50	20	5
n° obs. Middle		30		25	8	64	37	21	112	35	40	50	20	5
n° obs. High		30		25	7	64	37	20	112	34	39	50	20	5
n° obs. Total		90		75	22	192	111	62	336	104	119	150	60	15

Source: our calculations from ECHP 1993-1997

Table 3: Public Pension Expenditures in European Countries (% of GDP)

Country	Germany	Denmark	Netherlands	Belgium	Luxembourg	France	United Kingdom	Ireland	Italy	Greece	Spain	Portugal	Austria	Finland
2000	11.8	10.5	7.9	10.0	7.4	12.1	5.5	4.6	13.8	12.6	9.4	9.8	14.50	12.10
2010	11.2	12.5	9.1	9.9	7.5	13.1	5.1	5.1	13.9	11.9	8.9	11.8	14.4	11.7
2020	12.6	13.8	11.2	11.4	8.2	15	4.9	6.8	14.8	14	9.9	13.1	14.7	13.6
2030	15.5	14.5	13	13.3	9.2	16	5.2	7.5	15.7	16.8	12.6	13.6	15.8	14.7
2040	16.6	14	14	13.7	9.5	15.8	5	8.5	15.7	20.2	16	13.8	15.2	14.8
2050	16.9	13.3	13.6	13.3	9.3	15.8	4.4	8.5	14.1	20.8	17.3	13.2	13.50	14.80

Source: European Commission (2001)

Table 4. Replacement rates for low income individuals

	Germany	Denmark	Netherlands	Belgium	Luxembourg	France	United Kingdom	Ireland	Italy	Greece	Spain	Portugal	Austria	Finland
Replacement Rate bottom 33.33%	n.a.	1.2749	n.a.	0.9208	3	1.0295	2.1667	0.7084	1.0500	0.9722	1.0707	1.2177	1.0303	1.3495
n° obs.		30		25	7	64	37	21	112	35	40	50	20	5
Replacement Rate bottom 20%	n.a.	2.0017	n.a.	1.3171	3	1.2169	2.3067	0.7566	1.5648	1.2850	1.1567	1.4682	1.7864	1.5040
n° obs.		18		15	5	38	22	12	67	19	24	30	12	3

Source: our calculations from ECHP 1993-1997

Table 5: Measures of Inequality in European Countries

Country	Germany	Denmark	Netherlands	Belgium	Luxembourg	France	United Kingdom	Ireland	Italy	Greece	Spain	Portugal	Austria	Finland
Gini index	30	24.7	32.6	25	26.9	32.7	36.1	35.9	27.3	32.7	32.5	35.6	23.1	25.6
Lowest 20%	8.2	9.6	7.3	9.5	9.4	7.2	6.6	6.7	8.7	7.5	7.5	7.3	10.4	10
II+III+IV 20%	53.4	55.9	52.6	56	54.1	52.6	50.4	50.4	55	52.2	52.2	49.3	56.3	54.2
Highest 20%	38.4	34.5	40.1	34.5	36.5	40.2	43	42.9	36.3	40.3	40.3	43.4	33.3	35.8
Survey year	1994	1992	1994	1992	1994	1995	1991	1987	1995	1993	1990	1994-95	1987	1991

Source: World Development Indicators. World Bank 2000

Table 6: Second pillar and financial indicators

Country	Germany	Denmark	Netherlands	Belgium	Luxembourg	France	United Kingdom	Ireland	Italy	Greece	Spain	Portugal	Austria	Finland
Pension funds assets as %GDP (1993)	5.8	20.1	88.5	3.4	n.a.	3.4	79.4	40.1	1.2	n.a.	2.2	n.a.	n.a.	n.a.
Supplementary pension as % of total pension (1993)	11	18	32	8	na	21	28	18	2	n.a.	3	n.a.	n.a.	n.a.
Source: Green Paper EC 1997. Based on European Federation for Retirement Provision (EFRP)-European Pension Funds 1996														
Country	**Germany**	**Denmark**	**Netherlands**	**Belgium**	**Luxembourg**	**France**	**United Kingdom**	**Ireland**	**Italy**	**Greece**	**Spain**	**Portugal**	**Austria**	**Finland**
Total Value of Pension funds (US$ billions)														
1998	172	n.a	470	9	n.a	77	1159	46	n.a	n.a	n.a	13	n.a	n.a
1999	215	n.a	400	10	n.a	70	1385	49	n.a	n.a	n.a	13	n.a	n.a
2000	188	n.a	441	14	n.a	85	1256	50	n.a	n.a	n.a	11	n.a	n.a
Source: Watson Whyatt														
Country	**Germany**	**Denmark**	**Netherlands**	**Belgium**	**Luxembourg**	**France**	**United Kingdom**	**Ireland**	**Italy**	**Greece**	**Spain**	**Portugal**	**Austria**	**Finland**
Pension funds 1984-93. Average Nominal Rates of Return (Real in parenthesis)	9.4 (7.1)	10 (6.3)	9.5 (7.7)	11.8-(8.8)	n.a.	n.a.	15.5 (10.2)	14 (10.3)	n.a.	n.a.	13.8 (7)	n.a.	n.a.	n.a.
Market capitalization in % of GDP (1996)	29.6	41.8	97.8	45.9	193.4	38.9	149.9	49.7	21.7	19.7	42.3	23.7	14.3	50.7

Source: Green paper EC1997. Based on Federation of European Stock Exchanges and European Commission

FIGURE 1